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ABSTRACT

Due to the increasing achievement gap between schools of urban settings and their suburban counterparts, and in an environment where statewide testing that may begin to hinder the graduation of many urban students, there is a need to close the gap especially in the areas of Math and Science. Teachers in such environments face the daunting task of accelerating learning for urban students in two arenas: conceptual and affective. The conceptual tasks observed during this study included: building up the basic skills of students, developing literacy and proficiency around test taking, as well as completing the curriculum for Calculus. The primary affective tasks observed during this study included: confidence (swagger) development; positive interaction around the "Truth" of their academic status; and work ethic development. In order to do all of the conceptual and affective tasks in a limited amount of time, acceleration was needed. The purpose of the proposed teacher-action research case study was to meet those conceptual and affective needs while accelerating student learning. Out of this emerged a new educational paradigm, known as Quality Complex Instruction (QCI), which was developed by integrating the cooperative aspects of Complex Instruction with the intentional management techniques of Total Quality Management. From the analysis of interviews, survey data and observations during this study, a conceptual framework developed, known as the QCI spiral, that addressed the specific conceptual and affective needs of students in order to accelerate learning. The objective of this framework was to develop a model that validated both the conceptual and affective components of learning, as well as integrated them in a framework that allows them to be dealt with simultaneously in an urban mathematics classroom setting. The implications of this research include the use of Tom Sawyer heuristic development in urban math classrooms, to make high level challenges a pleasure. Also the use of Spiraling, Deliberate memory, Algorithms, Recapitulation and Test based problem solving (SMART) methods of teaching that developed out of the QCI spiral. Another major finding that developed from this research is the development of data informed "Swagger" development, management and maintenance. Because of issues around basic skills, self-image, test taking ability, students in this environment were subject to what Claude Steele would call "Stereotype Threat". This creates an environment in which students of color under perform. To counter this hindrance in the setting studied, data and group accountability are vital to 'show the students the truth' of where they are, but to also develop a sense of confidence, based on skill development that helps them to see themselves succeeding, therefore internalizing a deeper work ethic. (Contains 62

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SUPPORTING IRON SHARPENING IRON: DEVELOPING A SWAGGER IN THE HEARTS OF URBAN MATH AND SCIENCE STUDENTS

A paper

by

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Abstract:

Due to the increasing achievement gap between schools of urban settings and their suburban counterparts, and in an environment where statewide testing that may begin to hinder the graduation of many urban students, there is a need to close that gap especially in the areas of Math and Science. Teachers in such environments face the daunting task of accelerating learning for urban students in two arenas: conceptual and affective. The conceptual tasks observed during this study included: building up the basic skills of students, developing literacy and proficiency around test taking, as well as completing the curriculum for Calculus. The primary affective tasks observed during this study included: confidence (swagger) development; positive interaction around the "Truth" of their academic status; and work ethic development. In order to do all of the conceptual and affective tasks in a limited amount of time, acceleration was needed. The purpose of the proposed teacher-action research case study was to meet those conceptual and affective needs while accelerating student learning. Out of this study emerged a new educational paradigm, known as Quality Complex Instruction (QCI), which was developed by integrating the cooperative aspects of Complex Instruction with the intentional management techniques of Total Quality Management. From the analysis of interviews, survey data and observations during this study, a conceptual framework developed, known as the QCI spiral, that addressed the specific conceptual and affective needs of students in order to accelerate learning. The objective of this framework was to develop a model that validated both the conceptual and affective components of learning, as well as integrated them in a framework that allows them to be dealt with simultaneously in an urban mathematics classroom setting. The implications of this research include the use of Tom Sawyer heuristic development in urban math classrooms, to make high level challenges a pleasure. Also the use of Spiraling, Deliberate memory, Algorithms, Recapitulation and Test based problem solving (SMART) methods of teaching that developed out of the QCI spiral. Another major finding that developed from this research is the development of data informed "Swagger" development, management and maintenance. Because of issues around basic skills, self image, test taking ability, students in this environment were subject to what Claude Steele would call "Stereotype Threat". This creates an environment in which students of color under perform. To counter this hindrance in the setting studied, data and group accountability are vital to "show the students the truth" of where they are, but to also develop a sense of confidence, based on skill development that helps them to see themselves succeeding, therefore internalizing a deeper work ethic.

The need for acceleration in Math and Science Learning in Urban Settings

To acknowledge that education, particularly in mathematics, has improved over the past 20 years (National Center for Educational Statistics, NCES 2000) is not to suggest that everything is fine, especially with students of color who predominate urban schools and will become the majority of students in US public schools by 2020 (Banks 1991). There exist ever widening gaps in mathematics achievement, in many areas, but most dramatically between most students of color (specifically African Americans, Hispanics and Latinos, and Native Americans) and Caucasian and Asian- American students. Though more students of color are academically "successful" as determined by increasing averages on standardized tests and ranks in schools, these increases do not come close to "matching the growth of their share of the student-age population" (College Board, 1999 p. 3). The College Board also acknowledges that an educational system that allows for such persistent gaps and not intentionally addressing them would be socially divisive, and unjust.

> When a great many individuals-and entire groups of people-do not have a genuine chance to develop their academic talents fully, our society is much poorer for their lack of educational opportunities. Even more important, this is fundamentally unjust and is potentially an enormous source of social divisiveness, as the growing debate over affirmative action is beginning to show. College Board, 1999 p. 5.

The issue of achievement gap in mathematics goes beyond race. There is an achievement gap between the US and other countries as well; consequently, the issue of overcoming gaps in mathematics learning is pertinent to all US mathematics and science classrooms. Many reform efforts in mathematics and science education point to the poor performance of schools from the US on the Third International Mathematics and Science Study (TIMSS). The US faired poorly,

near the bottom on the (TIMSS) test given to over 40 countries; however, what is lost is great number of successes in America. Students in Northbrook, Illinois, for example finished second in mathematics and first in science on the TIMSS (Chase 1999). This occurred because as a school system across grade levels, there was an intentional plan that focused on challenging all students. Our goals have historically been for a small minority to be successful in college. As these goals have shifted, and more students go on to college, businesses have needed workers that are more skilled. When we see how poorly we have done with respect to other countries, we suddenly become motivated to improve. Being reactionary in this way does not build long-term goals across levels. A healthy examination of the interconnected methods, purposes, and styles of education can begin the intentional sharpening process of education itself, and the students it impacts as well.

These achievement gaps can only be undone by intentionally accelerating, scaffolding, monitoring, and adjusting the learning of those who are behind those who are ahead. There are many proven and promising strategies for raising minority achievement, many of which have an Instructionalist focus: Marva Collins in Chicago, Jaime Escalante' with Advanced Calculus in Los Angeles, Thaddeus Lott in Houston. For a constructivist paradigm to work effectively, there has to be social interaction, knowledge construction, and scaffolding by learned others. Complex group instruction can create such a constructivist environment by developing "Learned" others and resources that multiply the teacher's effectiveness, and can allow for accelerated learning of the group. Total Quality Management can provide intentional feedback for improvement of the system of learning that should help address accelerating student achievement.

As the teacher-researcher of this study, I came into the urban classroom setting, having myself gone to an urban high school, yet having also taught in both affluent private and suburban

settings for over 10 years. The diversity of these previous experiences enabled me to have a first-hand perspective on the achievement gap (Lee Consulting, 2000), in the US between affluent suburban students and their urban counterparts. Much research and money is being spent on how to overcome this gap, and many states are going to mandatory statewide tests with predetermined passing standards in order to assess where students are, and to motivate students and school systems to improve. As a teacher-researcher with first hand contact with students from diverse settings, it was obvious to me that the innate intellectual ability of students in these various contexts were similar, and the ability and dedication of teachers was also similar. The widespread difference in achievement on standardized tests therefore cannot be easily explained as a result of external conceptual issues or limitations due to location, ethnicity or class. The gap in academic conceptual achievement (part of the head of learning) however is very real, but only part of the gap. Affective issues (at the heart of learning) around desire to learn, work ethic and focus are equally real, as well as the level of opportunity of challenging academic tasks (hand of learning) that help sharpen students. In order to overcome such gaps, especially at the secondary level, acute acceleration must take place in order to equip many urban students to be on equal footing with their suburban counterparts once they enter college, especially in the area of mathematics.

A unique aspect of this study is that it addressed the achievement gap, by not focusing on improving how students in this urban setting can do better on standardized and statewide tests, or on lower level courses, but going beyond those standards to college level courses. Because of my experience in affluent suburban and private schools, it is easy to see that to increase the quality of education, one has to strive to go well beyond the minimum level. Passing statewide are often well below the expectations of the students in those environments. If an urban school was to wait until it was ready to give AP courses, they may not ever be ready, because of the affective human element

of expectation. Once a level of expectation is achieved, it is very tempting to become satisfied. Historically, Japan is known for its level of quality in automobile manufacturing (Aguayo, 1991), not because they reach their goals, but because their goals are so high (perfection) they rarely ever reach them. American automobile quality historically, has been known by reachable standards, once reached were rarely ever improved upon, until forced to by competition such as Japan. One basic premise of this study is that in order to close the achievement gap, urban schools must become like Tom Sawyer, creating an environment in which work at the highest level, really isn't work, but a means of reaching one's potential. In order to change a school's environment, having the right fences to paint may mean the difference between work that never gets done, and creating an environment that makes learning at the highest level pleasurable.

This interactive teacher-research study began as an attempt to accelerate learning in an urban mathematics classroom by utilizing Total Quality Management and Complex Instruction techniques. TQM was the same model used by much of Japan's industry that overcame their "quality" gap to become a worldwide quality leader in manufacturing, despite having limited physical resources. Though they had limited physical resources, Japan industry maximized its human resources to create environments and expectations of quality of the highest level. To more effectively utilize human resources during the study, a modified CI model of instruction was introduced into the classroom setting. By the intentional development of inter-dependent students with such a model, the teacher has access to greater human resources that promote acceleration of learning, as well as the continuous improvement of the classroom environment.

Honest, humane, and healthy examination is the first step for improvement of quality in schools, but this examination cannot be done apart from the social and human component that is at the heart of education. Researchers such as Apple (1995) have written that schools are "contested

terrains" crucial arenas in which the struggle over ideas values, and power in society are acted out" (Lipman, 1998, p.8). For the socially and economically marginalized to contest or fight over any land that is occupied by those who are in power, they must be equipped with sharpened academic tools, and an empowered mindset. If they posses those two things, they should have access to that land and authority to make decisions on its use and development. This should not be to simply revolt and take power, as those already in power may have done, but to be socially mature, and reduce competition for power, and to share strengths for the excellence and sharpening of all who inhabit the contested terrains. This paper is developed from a Ph.D. dissertation that deals with topics brought out in this paper, but in much more detail. This paper primarily deals with how the QCI paradigm conceptually accelerates learning while also affectively initiating, developing and maintaining internalized academic confidence-known as Swagger.

Background of the Study

Purpose of Study

The purpose of this teacher-action research case study was to integrate the cooperative aspects of Elizabeth Cohen's (1994) Complex Instruction (CI) with the management techniques of Total Quality Management to develop an new integrated paradigm, known as Quality Complex Instruction (QCI). Through the blending of TQM and CI, the Quality Complex Instruction paradigm developed. The QCI paradigm has several components and best practices that developed as the study progressed. Primary components of the QCI paradigm as used in this study include:

- Having a clearly defined goal at the highest level of learning possible (the AP exam in the case of this study).

- Has a spiral framework in which the conceptual aspect of learning (including higher order problem solving for this study) is the vertical component of the spiral, while the inward component of the spiral deals with the affective aspect of learning (including motivation work ethic, and internalization of algorithms during this study)
- Having such a high goal at the top of the spiral, requires interdependence of the human resources to reach goals. The job is too big for the teacher alone, using traditional methods to accomplish. Students are needed to help scaffold and construct the QCI spiral and their own math knowledge.
- The spiral framework is built and maintained via intentional, socially constructed interactions between those constructing their own knowledge and those scaffolding that construction. These interactions take place around quality academic tasks, managed by the teacher.
- The teacher is the intentional manager and developer of the quality heuristic learning environment.

Methodology

The QCI paradigm developed out of the design of this teacher-researcher case study. The design of the research attempted to combine both form and function into one cohesive unit. In order to analyze the components of knowledge construction, it was assumed that the teacher research, like people, have interwoven affective and conceptual components. This study likewise had affective and conceptual parts, needing both qualitative and quantitative approaches and data.

The primary data sources for this study consisted of Questionnaires, Interviews, Student work, Field notes, as well as test scores, SAT scores and grades of students. Several questionnaires were used to gain both quantitative and qualitative data. These questionnaires included:

1) Student Pre/Post course questionnaires to identify the impact of the Course on responses.
2) Exit questionnaires to get feedback on the course in general and specifically on things that developed after the course had started.
3) Senior student questionnaires that allowed for comparison between a regular and AP math class.

Interviews of individuals, support staff, and of focus group were also used during this study. A wide cross-section of the class is represented in the two recorded focus group interviews (14 of the class' 22 students), where many of the limited English proficiency students felt much more comfortable to speak, and where they had linguistic support as well when they had a loss for words. These were done to attempt to see different perspectives of the course, and of the QCI paradigm. The initial individual and focus group interview questions were adhered too, though many follow-up questions were also used for clarity and amplification.

Other primarily qualitative data sources obtained during this study included a limited amount of video taping of students as they worked in Complex Instruction groups, selected samples of students' work and a Teacher-Researcher reflective journal and field notes (some of which were lost because a computer at school with class field notes was stolen). The primary quantitative data sources include, class test and quiz scores, AP test scores, SAT test scores of regular and AP students, and GPAs of regular and AP students. These were used to find correlations, patterns along demographic and class lines, and relationships within the data.

Context of Research and Teaching

This study intentionally took place in an urban setting where the achievement gap is wide, particularly in math and science, and in a setting in which the student body is very diverse culturally and linguistically. The class of 22 students consisted of 40% Cape Verdian Students, and the rest of the students having a great diversity, from half white-half Eritrean, Jamaican, Vietnamese, Chinese, and African American. The teaching context particularly fit this study because it took place in an urban school in which high stakes testing is just about to be implemented, and standardized tests must be passed for students to graduate. AP tests had not been offered at the school for several decades up until the year before this study.

It was in this context that the study took place in which collaborative work was emphasized, group projects were performed, and academic tasks were managed using the QCI paradigm. The core conceptual needs of students including basic mathematics skills curricular content, and test taking skills were addressed. Affective issues were also addressed such as scaffolding of student knowledge construction in native languages when appropriate, Tom Sawyer style motivation and work ethic development.

Conceptual Framework

The conceptual framework of this study (see figure 1) evolved from a single quality loop process to a three dimensional spiral. Initially, the Conceptual framework centered around conceptual aspects of learning, and therefore only needed one interactive feedback loop for quality progression. As the study developed, it became -obvious that the affective components of learning were as important as the conceptual if not more so for the study. Progression was then assessed by how high up the spiral (higher order thinking) one would achieve, as well as how far inward (affective skills such as motivation and internalization) one would get as well.

In order to counter act issues around self image that hinder performance and achievement on tests specifically, one needs time. As a teacher who has seen students of color in private schools, and as a student of color who went to an integrated high school, I have seen that student of color tend to do better when they have peer groups that allow them to see themselves as part of the group, as well as seeing the "truth" that color has very little to do with academic performance. Many students of color from private schools performed much higher on standardized tests than their urban counterparts, and as I did as a rare male member of the honors classes in my predominately white honors classes. I feel that this is in part due to internalizing the truth of the relative academic skills of different peoples had been internalized in such environments. One could look at themselves as academic peers to white students, regardless of what race or neighborhood one came from.

The first component of Swagger development was therefore showing students the truth of where they were academically, while also showing them how simple the work they were about to do actually is. This was done by introducing the two basic components of Calculus- derivatives and integration, during the very first week of class. They saw how the power rule worked, and saw that it was something that they could handle. This gave them confidence, that had to be tempered with understanding that as the course progressed, issues around basic skills would also have to be addressed. This was done in non-condescending ways, such as to deal with student weaknesses in the areas of fractions. Use of the power rule in which one has to be subtracted from the exponent worked well in dealing with fractions because they were used to emphasize how one has multiply and subtract one from fractions. Another component of swagger development was the reminding student of what they already knew. A mantra of problem solving in the classroom setting was, "if you get stuck, do a similar problem you already know the answer to." By showing students that

they already knew how to do many parts of the problems that we were doing, encouraged them, but also gave them access to a skill that they had not net developed. Finally in dealing with swagger maintenance, recapitulation was often used. Students were given difficult free response problems, that had many parts, and supported through the solution. The similar, but not exact problems would then be given out regularly in order to show students that they could truly do higher level work.

Swagger development and maintenance had both conceptual and affective components. Developing quality learning helps one to develop a swagger is done on both the levels simultaneously. Once one builds up the skills of students then they see what they can do, once they see that they can do work at the highest level, then they need to have basic skills filled in, as well as work ethic. From this research, it was clear that one year was not enough to deal with the control loop issues that the students faced, but it was effective in allowing the students to see the 'truth" of what college work looks like, and helping them to feel more prepared. They developed a swagger that no challenge is too big, if they have access to effective conceptual and affective support that they need to excel.

Many things come into play in the achievement gap between urban students and their suburban counterparts. From this study one can see that in order to deal with such a complex problem, one needs to think holistically. The Head (the conceptual), the Heart (the affective), and the Hand (academic tasks) all come into play in order to truly accelerate learning. Most frameworks deal with the conceptual, and identify academic tasks, but often neglect the affective component of learning. It is often the most important aspect of learning in the urban setting. One cannot accelerate a class that does not have motivation, knowledge of their goals, and a desire to reach them. Consequently, conceptual and assessment tactics used in dealing with educational

reform often fall short. The QCI paradigm developed during this study integrates TQM and CI in order to integrate conceptual and affective components of learning around integrated SMART techniques. Use of such techniques like spiraling and deliberate memorization, if utilized effectively can help develop a Tom Sawyer heuristic of learning in which students see it more as a challenge and pleasure, rather than just another task to accomplish. As students grow in such a model, so does their confidence. As that confidence, as the academic components of the course are internalized, then a positive academic swagger can develop. That swagger can then become an internal scaffold for accelerated academic and test achievement.

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